

## PATENT SPECIFICATION

Application Date: May 8, 1936. No. 12986/36.

474,784

Complete Specification Left: May 3, 1937.

Complete Specification Accepted: Nov. 8, 1937.



### PROVISIONAL SPECIFICATION

#### Improvements in and relating to Objectives

We, HORACE WILLIAM LEE, a British Subject, and KAPELLA LIMITED, a British Company; both of 104, Stoughton Street, Leicester, do hereby declare the nature of this invention to be as follows:—

This invention relates to lens systems corrected for spherical aberrations, coma and astigmatism, of the type comprising two compound dispersive components between two collective components; and it has for its object to improve the correction of the secondary spectrum.

A known method of attaining the object of our invention is to employ for the dispersive elements glass in which the ratios of the partial dispersions between the lines  $b-C$ ,  $C-d$ ,  $d-F$ ,  $F-g$ ,  $g-h$  of the solar spectrum to the mean dispersion between the lines  $C$  and  $F$  do not differ from the corresponding ratios of the glass of each of the collective components by more than two per cent. Usually such

glass has a low mean dispersion indicated by a high value of the Abbé V number. 25

We prefer to employ glass, in the dispersive elements as aforesaid, which has an Abbé V number at least 20% less than that of the glass in either of the collective components, and to make the differences of the ratios of the partial dispersion to the mean dispersion of the glass of the dispersive elements and collective components respectively not greater than 2½% for  $b-d$ ; 1½% for  $e-F$ ; 3% for  $F-g$ , and 5% for  $g-h$ . 35

By an element we mean a lens consisting of a single piece of glass.

By a component we mean a lens whether simple or compounded of two or more elements and forming a component part of the lens system. 40

Dated the Seventh day of May, 1936.

KILBURN & STRODE,  
Agents for the Applicants.

### COMPLETE SPECIFICATION

#### Improvements in and relating to Objectives

We, HORACE WILLIAM LEE, British Subject, formerly of 104, Stoughton Street, Leicester, now of 52, Grove Park Gardens, Chiswick, London, W.4, and KAPELLA LIMITED, a Company registered under the Laws of Great Britain, of 104, Stoughton Street, Leicester, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an optical objective consisting of a lens system corrected for spherical aberration, coma and astigmatism, of the type comprising two compound dispersive components located between two collective components. The term "element" will be used herein to indicate a lens consisting of a single piece of glass, whilst the term "component" is used for a lens, whether simple or compounded of two or more elements, forming a component part of a lens system.

A known method of improving the correction of the secondary spectrum in

[Price 1/-]

such an objective is to employ for the dispersive elements glass in which the ratios of the partial dispersions between the lines  $b-C$ ,  $C-d$ ,  $d-F$ ,  $F-g$ ,  $g-h$  of the solar spectrum to the mean dispersion between the lines  $C$  and  $F$  do not differ from the corresponding ratios for the glass or glasses used in the collective components by more than 2%. Usually such glass has a low mean dispersion indicated by a high value of the Abbé V number. 70

The present invention has for its object to provide still better improvement in the correction of the secondary spectrum.

To this end according to the invention, the glass employed for a dispersive element in each dispersive component has an Abbé V number at least 20% less than that of the glass or glasses used in the collective components, and is such that the ratios of the partial dispersions to the mean dispersion differ from the corresponding ratios for the glass or glasses used in the collective components by not more than 2½% for  $b-d$ , 1½% for  $e-F$ , 3% for  $F-g$  and 5% for  $g-h$ . Each 85 90 95

dispersive component preferably consists of a dispersive element and a convergent element, and the same glass may be employed for the two collective components and for the convergent elements of the two dispersive components.

The accompanying drawing illustrates one convenient example of objective according to the invention for which numerical data are given below.

In this example the successive radii of curvature, counting from the front, are designated by  $R_1, R_2 \dots$ , the positive sign denoting that the surface is convex

towards the incident light and the negative sign that it is concave thereto; the axial thicknesses of the elements are indicated by  $D_1, D_2 \dots$ ; and the axial air separations of the components from one another are indicated by  $S_1, S_2 \dots$ . The glass of which each element is made is defined in terms of the mean refractive index  $n_D$ , in accordance with usual convention, and by the Abbé V number.

The numerical data for this example, which has a relative aperture  $F/2$  and the equivalent focal length 1.018, are set out in the following table:—

Radii	Thick-ness	Separa-tion	$n_D$	V.	Relative Partial Dispersions.				
					b--d	C--e	e--F	F--g	g--h
$R_1$ + .7152	$D_1$ .10		1.6133	59.3	.478	.543	.457	.544	.453
$R_2$ + 4.678									
$R_3$ + .4155	$D_2$ .105	$S_1$ .022	1.6133	59.3	.478	.543	.457	.544	.453
$R_4$ $\infty$									
$R_5$ + .2725	$D_3$ .035		1.6166	44.5	.469	.539	.461	.556	.471
$R_6$ - .2813									
$R_7$ + .3500	$D_4$ .025		1.6133	59.3	.478	.543	.457	.544	.453
$R_8$ - .3750									
$R_9$ + 3.750	$D_5$ .135	$S_2$ .160	1.6133	59.3	.478	.543	.457	.544	.453
$R_{10}$ - .7764									
	$D_6$ .070	$S_3$ .003	1.6133	59.3	.478	.543	.457	.544	.453

It will be noticed that in this example each dispersive component consists of a dispersive element compounded with a convergent element, which is made of the same dense barium crown glass as the two collective components, each dispersive element being made of a borate flint glass having an Abbé V number about 25% less than that of the dense barium crown glass.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. An optical objective comprising two compound dispersive components located between two collective components, in which the glass employed for a dispersive element in each dispersive component has an Abbé V number at least 20% less than that of the glass or glasses used in the

collective components, and is such that the ratios of the partial dispersions to the mean dispersion differ from the corresponding ratios for the glass or glasses used in the collective components by not more than 2½% for b--d, 1½% for e--F, 3% for F--g and 5% for g--h.

2. An optical objective as claimed in Claim 1, in which each dispersive component consists of a dispersive element and a convergent element, and the same glass is used for the two collective components and for the convergent elements of the two dispersive components.

3. The optical objective substantially as described with reference to the accompanying drawing.

Dated this 3rd day of May, 1937.  
KILBURN & STRODE,  
Agents for the Applicants.

*[This Drawing is a full-size reproduction of the Original.]*

